BEAVERHEAD TMDL PLANNING AREA SEDIMENT MONITORING

Sampling and Analysis Plan

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1.0 Introduction and Background

The majority of the Beaverhead TPA is located within Beaverhead County, with a small portion in Madison County and includes the towns of Dillon and Twin Bridges. The Beaverhead TPA encompasses the Beaverhead River Watershed below the Clark Canyon Dam, which begins at the outlet of the Clark Canyon Reservoir and flows northeast approximately 80 miles before joining the Big Hole River to form the Jefferson River. The TPA coincides with the 10020002 fourth-code hydrologic unit code (HUC), and is bounded by the Pioneer Mountains on the west, the Ruby Range to the east, and the Snowcrest Range and Blacktail Mountains to the south. The total extent of the TPA is 934,947 acres, or approximately 1461 square miles. Hydrology in the upper Beaverhead River is regulated entirely by Clark Canyon Reservoir. From October through March, water is stored in the reservoir for the upcoming irrigation season. Releases then occur from April through September. The main diversion of irrigation water occurs at the East Bench Diversion Dam located approximately three miles below Grasshopper Creek (eleven miles below Clark Canyon Reservoir).

Under Montana law, an impaired water body is defined as a water body for which sufficient and credible data indicates non-compliance with applicable water quality standards (MCA 75-5-103). Section 303 of the Federal Clean Water Act requires states to submit a list of impaired water bodies or stream segments to the U.S. Environmental Protection Agency (EPA) every two years. Prior to 2004, this list was referred to as the "303(d) list", but is now named the "Integrated Report". The Montana Water Quality Act further directs states to develop TMDLs for all water bodies appearing on the 303(d) list as impaired or threatened by "pollutants" (MCA 75-5-703).

Within the Beaverhead TPA, there are 17 water body segments listed on the 2008 303(d) List for sediment-related impairments **(Figure 1)**: the Beaverhead River (Grasshopper Creek to mouth), Blacktail Deer Creek, Clark Canyon Creek, Dyce Creek, Farlin Creek, French Creek, Rattlesnake Creek (Upper and Lower), Reservoir Creek, Scudder Creek, Spring Creek, Steel Creek, Stone Creek (Upper and Lower), Taylor Creek, West Fork Blacktail Deer Creek, and West Fork Dyce Creek. Streams identified in this sampling strategy include all of the streams listed above and also Grasshopper Creek and the Upper Beaverhead River (Clark Canyon Dam to Grasshopper Creek), which have a habitat alteration impairment that is potentially linked to sediment impairment. Additionally East Blacktail Deer Creek is not listed for sediment but contains a DEQ reference site and is included within this SAP to provide reference data. The field methods conducted under this SAP are intended to assist DEQ in evaluating the impairment status of streams in the Beaverhead TPA and for developing TMDLs where necessary.

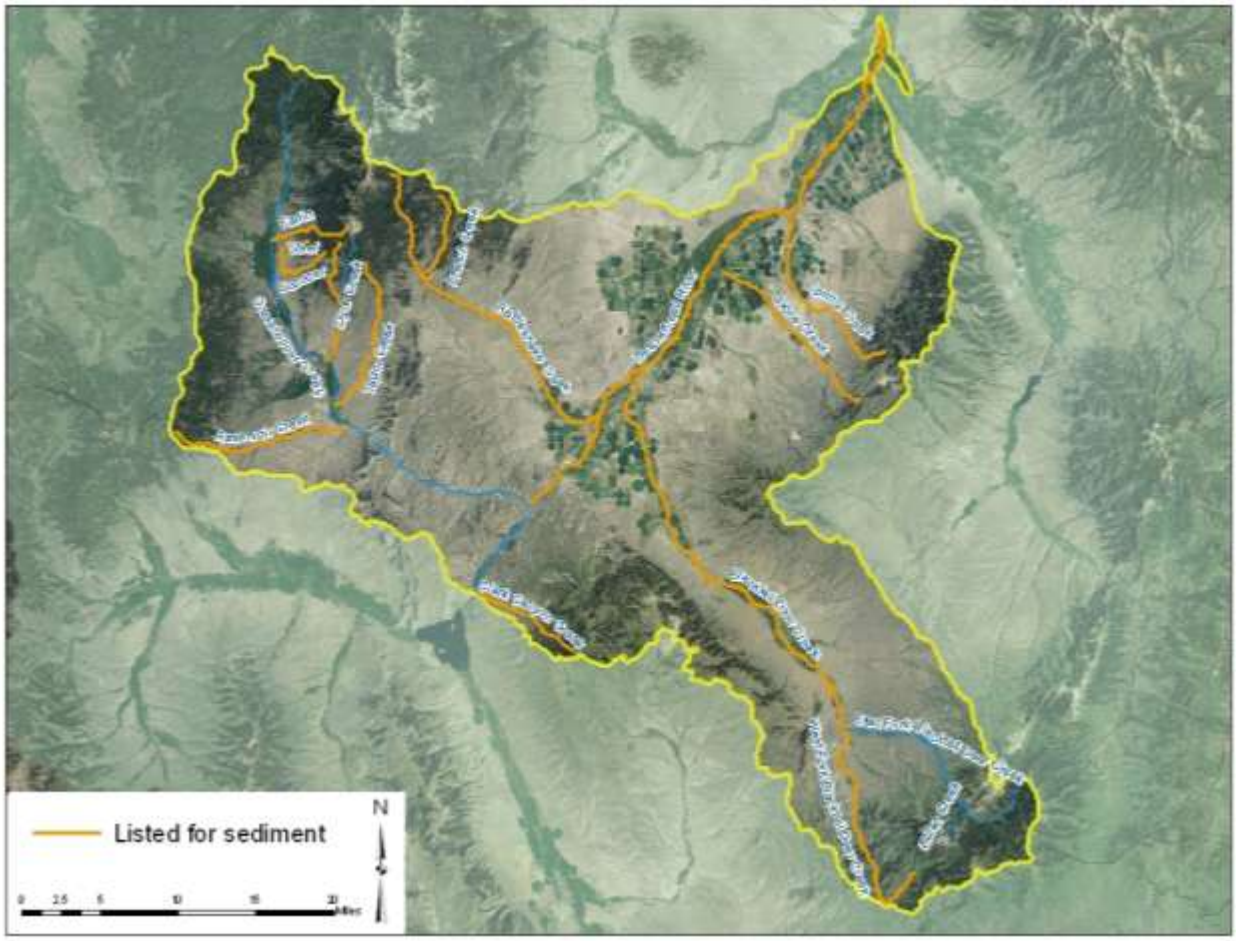

Figure 1: Beaverhead TPA 2008 303d Sediment Listed Streams

2.0 Objectives and Design

The objective of this sampling plan is to collect sediment and stream habitat data that will be used for the following:

- Verification of sediments impairment conditions on 303(d) listed tributaries in the Beaverhead TMDL Planning Area
- Quantification of sediment loads associated with specific land use categories in the Beaverhead TMDL Planning Area to assist in TMDL sediment load allocations

Study Design

In order to meet the above objectives, substrate character and stream habitat conditions will be determined by extensive water quality sampling in the listed tributaries within the Beaverhead TPA. Longitudinal surveys that include pebble counts, grid toss, cross sections, pool data collection, riparian greenline surveys, and eroding bank information will be performed at each of the selected sample sites in September of 2010.

Following procedures described in the document *Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations* (DEQ 2008), listed stream reaches within the Beaverhead TPA were stratified by ecoregion, stream order, valley gradient, and channel confinement. An additional stratification was performed through the use of aerial photography in order to identify distinct riparian conditions and to note areas of apparent local impacts.

Selection of Candidate Assessment Reaches

Candidate assessment reaches were selected in relatively low-gradient portions of the study streams to facilitate the evaluation of sediment loading impacts. Other considerations in selecting candidate assessment reaches included representativeness of the candidate reaches to other reaches of the same slope, order, confinement and ecoregion, as well of ease of access.

Within each candidate assessment reach, survey reaches ranging from 500, 1000, or 2000 feet will be established based on bankfull width of the stream during the field assessment. Refer to the *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MT DEQ, 2010) for additional details.

Selection of Limited Assessment Reaches

The Beaverhead River is a 7^{th} order stream and depending on flow and wadeability of the river at the time of sampling, may call for a limited or alternate assessment (Wilhelm et al. 2005; Kauffman 2000). Streamflow in the Beaverhead River are regulated at Clark Canyon Dam and vary widely throughout reaches downstream depending on irrigation use and irrigation return flows. In addition, stream channel substrate in some reaches of the lower Beaverhead River is composed of deep fine sediment. Consequently, some of the assessment methods for wadeable streams may not be feasible in some reaches of the Beaverhead River. The methods used in non-wadeable reaches will represent a subset of the standard protocols used for wadeable reaches (MT DEQ, 2010), but not all data may be possible to collect in non-wadeable reaches, and the approach to collecting the data will necessarily be modified as flow conditions dictate. Variables will be collected in a way that will allow comparison with data from wadeable reaches. Any modifications to the standard protocols will be approved by DEQ prior to implementation and will be documented as part of the field notes for each reach.

Farlin Creek, Scudder Creek, and Steel Creek (smaller 1^{st} and 2^{nd} order streams) may involve limited sampling based on their size and observable source contributions. For example, small stream size may limit detailed sampling of fines in pool tail-outs using the standard 48 point grid or may limit the number of points measured for cross-sectional data. As well, areas with severe flow alteration or disturbance may not have indications of regular bankfull flow.

The complete sediment and habitat assessment methodology is anticipated to be performed at 27 sample sites (including 1 reference site), as well as modified assessments for non-wadeable stream conducted at 3 sites and a BEHI-only assessment performed at 5 sites (see **Table 1**).

Sampling Reaches

35 sediment sampling reaches spatially distributed throughout the Beaverhead TPA were selected for inclusion in this project (**Figure 2**). Sampling reaches were chosen to include streams where data will assist with impairment determinations, as well as represent the range of landscape characteristics and land use/land cover influences existing in the watershed. Sampling reaches were identified based on the results of the stratification procedure, which incorporates stream order, valley confinement and slope, and ecoregion, and also an aerial analysis of the dominant land use/land cover adjacent to the stream (e.g. urban and residential areas, forest, logging, irrigation, grazing, row crops, and riparian area).

Based on the draft SAP, the representativeness of proposed and alternate sample sites and the riparian health conditions assigned during the stratification process were evaluated during a field reconnaissance trip to determine the final sample site list (**Table 1 and Figure 2)**. Any modifications to this final sample site list due to access issues will be documented and included in final protocols and site selection distributed to the assessment crew prior to the initiation of field work.

Table 1. All potential sediment assessment reaches in the Beaverhead TPA.

Waterbody	Full Assessment Reach	BEHI-only Reach	Non-wadeable Reach (Modified methods)
Beaverhead River (Lower)			BEAV 09-04
		BEAV 09-06	
	BEAV 09-10		
	BEAV 09-11		
			BEAV 09-14
			BEAV 09-15
Beaverhead River (Upper)		BEAV 04-05	
	BEAV 04-02		
Blacktail Deer Creek	BLKD 02-08		
	BLKD 02-16		
Clark Canyon Creek	CLKC 32-01		
	CLKC 19-02		
		CLKC 18-02	
Dyce Creek	DYCE 02-02		
East Fork Blacktail Deer Creek*	EFBK 22-01		
Farlin Creek	FARL 28-01		
French Creek	FREN 23-01		
		FREN 30-01	
Grasshopper Creek	GRAS 12-01		
	GRAS 20-11		
Rattlesnake Creek (Lower)	RATT 60-04		
Rattlesnake Creek (Upper)	RATT 54-04		
Reservoir Creek	RESR 20-01		
	RESR 11-01		
Scudder Creek	SCUD 14-01		
Spring Creek	SPRG 33-09		
	SPRG 33-16		

Waterbody	Full Assessment Reach	BEHI-only Reach	Non-wadeable Reach (Modified methods)
Steel Creek	STEL 10-01		
Stone Creek (Lower)	STON 22-02		
Stone Creek (Upper)	STON 05-01		
	STON 20-02		
Taylor Creek	TAYL 32-01		
		TAYL 27-01	
West Fork Blacktail Deer Creek	WFBK 08-04		
West Fork Dyce Creek	WFDY 17-01		

*Reference reach to be completed by DEQ WQPB Monitoring and Assessment Section 2010

The selected reaches span a wide range of stream size and flow conditions. Flow on many streams in the Beaverhead, particularly the Beaverhead River itself, is highly altered and regulated for irrigation needs. The Beaverhead River is controlled as outflow from Clark Canyon Reservoir and much of the flow released from the dam is captured again for the East Side Canal near Barretts. Complicating the situation, water returns to the Beaverhead River as surface and subsurface irrigation returns, which could only be accounted for with extensive flow measurement and modeling.

Bankfull discharge was estimated for each reach based on drainage area above sample site reaches and regional curve regressions. Gauge station data were used to extrapolate flows based on relative drainage area for sites on the Beaverhead River. Flow estimates are presented in **Attachment A**. The regional curve estimates do not consider irrigation withdrawals and returns, and are expected to be high. In addition, gauge data used to estimates average peak flow include data from previous decades, and examination of the peak flow data for the USGS gauges reveals a declining trend in peak flow, with peaks in recent decades much lower than historic levels. These estimates provide a general representation of relative stream sizes at the selected reaches and flow patterns along the length of the Beaverhead River. Drainage area used for estimating peak discharge at assessment reaches only extends to Clark Canyon Dam. Flows discharged from the dam mostly determine the available water in the Beaverhead River above Barretts, where the East Bench Canal is withdrawn. Dam releases from the 2009 water year, the most recent water year with complete data, are illustrated in Figure 3. The peak flow estimates for the reaches upstream of Barretts are based on regional curve regressions and do not reflect cam outflow discharge levels. Based on the 2009 water year discharge data for Clark Canyon Dam the expected peak flow would be closer to 800 cfs, a large portion of which is taken out at the East Bench Canal below the Barretts gauge station. The estimated peak discharge based on dam discharge data has been added to the estimates included in **Attachment A**.

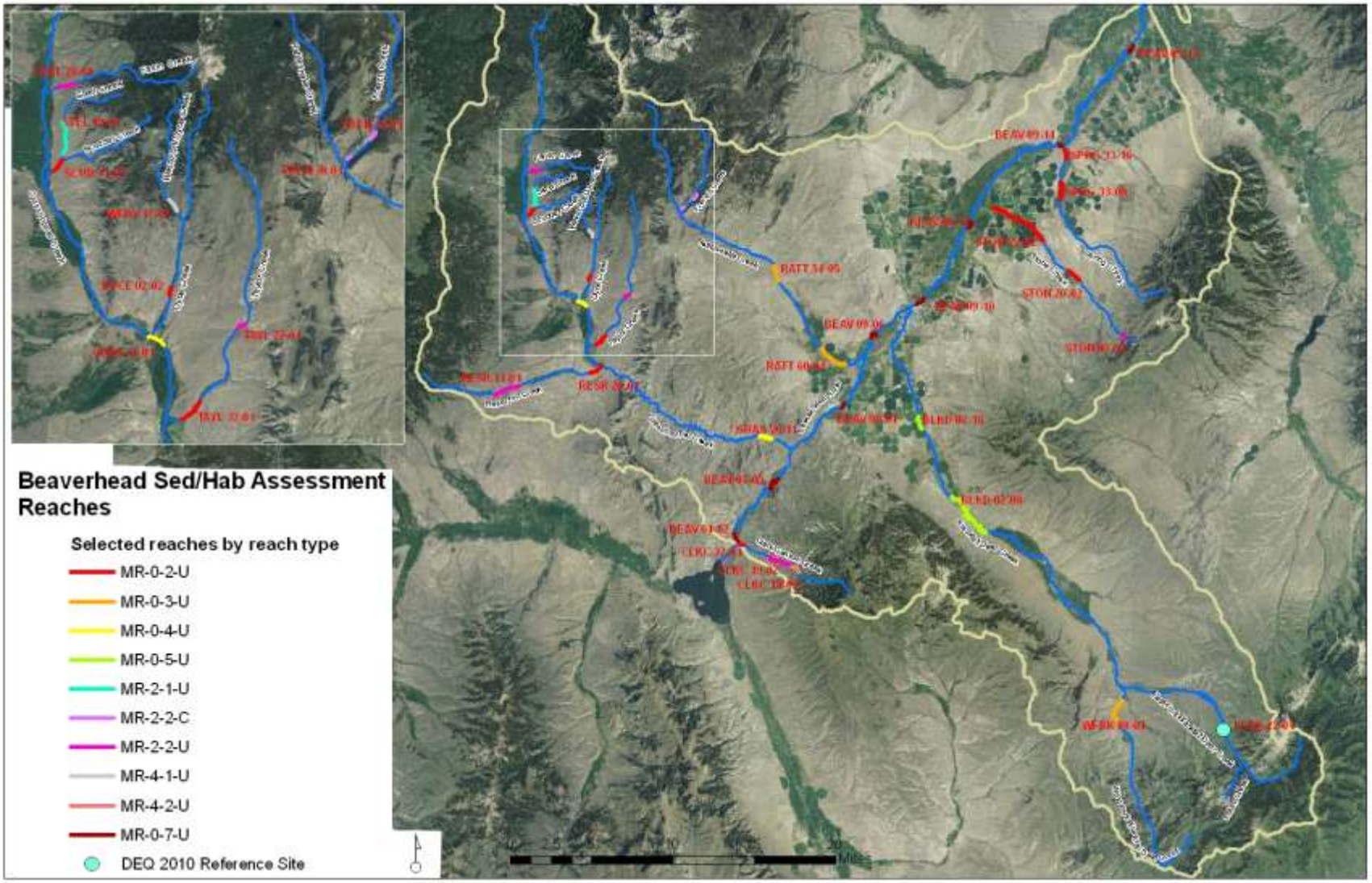

Figure 2: Proposed Sediment and Habitat Sampling Reaches for Sept. 2010 Field Work

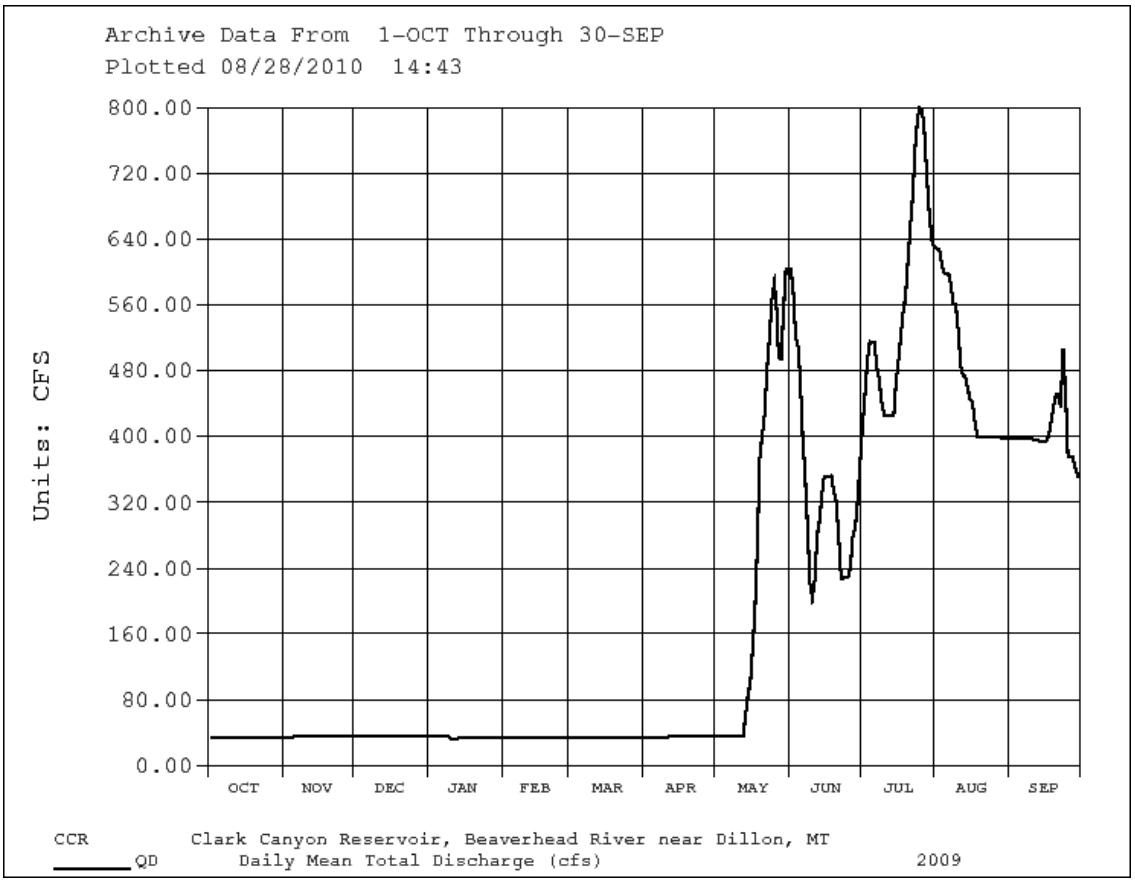

Figure 3. Discharge data form Clark Canyon Reservoir, 2009 water year.

Figures 4 and 5 are hydrographs illustrating flow levels during the past water year compared with the median flows for the period of record at USGS gauge stations near Barretts in the upper watershed and near Twin Bridges in the lower watershed. Most gauge stations in the watershed currently do not have continuous data throughout the year, as is the case for the gauge station near Twin Bridges.

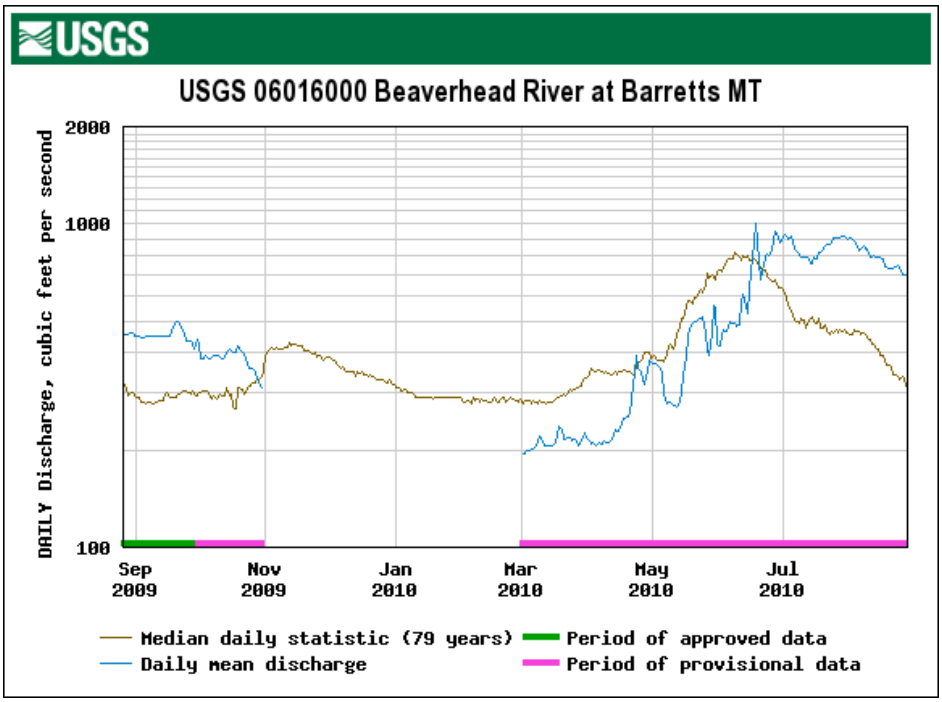

Figure 4. Daily mean discharge, Sep. 2009 to Aug. 2010, and median daily discharge for period of record at Barretts gauge station.

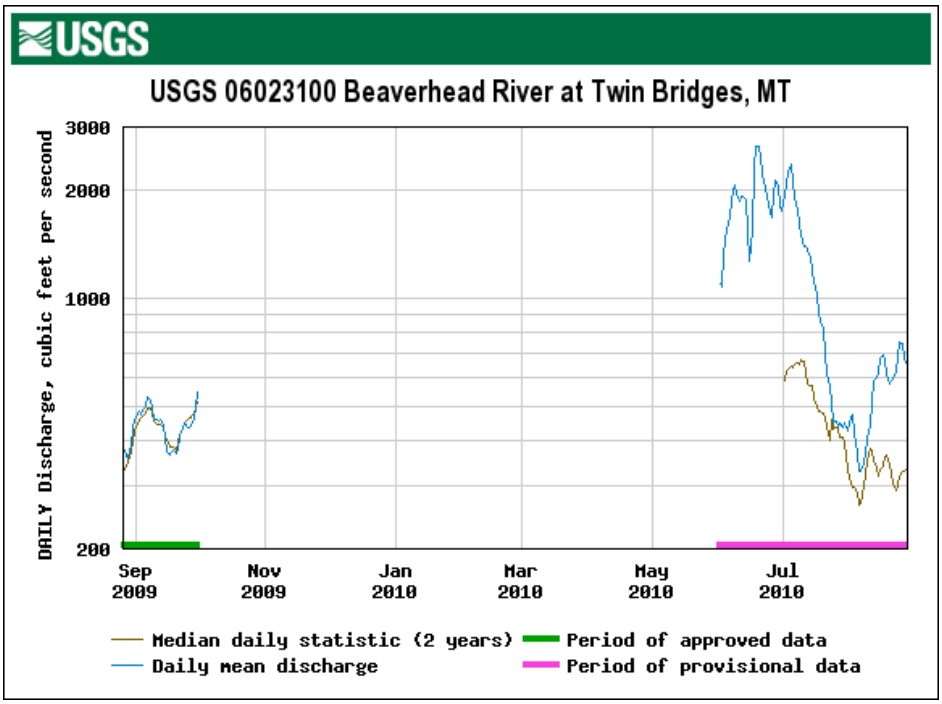

Figure 5. Daily mean discharge, Sep. 2009 to Aug. 2010, and median daily discharge for period of record at Barretts gauge station.

3.0 Field Sampling Methods

All monitoring and data collection will be done in accordance with the approach described in *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MT DEQ, 2010) and *MDEQ's Field Procedures Manual* (DEQ 2005). Because the approach for assessment of TMDL sediment and habitat impairments is evaluated annually, there may be some slight changes to the procedure. Any alterations of the procedure will be determined by the DEQ TMDL project manager and will be discussed with all field crew members before field work begins. Additionally, protocols may be revised for non-wadeable reaches; these protocols will be finalized prior to the sampling period and will be discussed with all field crew members before field work begins.

4.0 Quality Assurance and Quality Control Requirements

Data Quality Objectives (DQOs) are the quantitative and qualitative criteria established for a sampling design in order to meet the project's objectives. Data Quality Indicators (DQIs) are quantitative criteria established for the data acquired within this design to assure it is of sufficient quality for its intended use.

DQOs

Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This is a judgmental sampling design using the following rationale:

Spatial representation:

Sampling sites were chosen to represent the potential of landscape characteristics and land use/ land cover influences existing in the watershed to influence the stream substrate character, and stream morphology and habitat conditions. Sampling sites were identified by both assessment of aerial images and field surveying to capture the variability in land use and watershed characteristics potentially contributing to sediment impairment issues in streams including: stream order, valley confinement and slope, ecoregion, and land use/land cover (e.g. known mined areas, forest, grass, riparian area, geology, and soils).

Table 2 shows the distribution of sampling reaches relative to the number of distinct reach types grouped by stream order, valley confinement and slope, and ecoregion. Although it is not indicated within Table 2, sampling reaches within each reach type also reflect an attempt to capture variability in land use/cover.

Temporal representation

This study is designed to document a stream's geometry, riparian condition, and substrate characteristics. It uses bankfull width and depth for many of its measures, which is based upon a 1.2 – 2.0 year return cycle.

Table 2. Distribution of Assessment Reaches Relative to Stratified Reach Types. The reach types are presented as Level III ecoregion (MR = Middle Rockies)-slope-stream order-confinement.

Reach Type	Number of Stratified Reaches	Number of Sampling Reaches	Creeks Selected for Reach Assessment	Number of BEHI only reaches
MR-0-1-U	3			
MR-0-2-C	5			
MR-0-2-U	53	9	Spring (2), Stone (2), CCC (1), Reservoir (1), Dyce (1), Scudder (1), Taylor (1)	
MR-0-3-U	62	4	EBTDC **Reference** Reach* (1), WBTDC (1), Rattlesnake (2)	
MR-0-4-C	13			
MR-0-4-U	34	2	Grasshopper (2)	
MR-0-5-U	30	2	Blacktail Deer (2)	
MR-0-7-C	2			
MR-0-7-U	32	8	Beaverhead River (6)	Beaverhead River (2)
MR-10-1-C	34			
MR-10-1-U	29			
MR-10-2-C	8			
MR-10-2-U	5			
MR-10-3-C	1			
MR-2-1-C	11			
MR-2-1-U	14	1	Steel (1)	
MR-2-2-C	29	2	French (1)	French (1)
MR-2-2-U	51	5	Stone (1), Reservoir(1), Farlin (1), CCC (1)	Taylor (1)
MR-2-3-C	5			
MR-2-3-U	23			
MR-2-4-C	1			
MR-4-1-C	2			
MR-4-1-U	6	1	West Fork Dyce (1)	
MR-4-2-C	5			
MR-4-2-U	3	1		CCC (1)
MR-4-3-C	1			
MR-4-3-U	1			
TOTAL	**463**	**35**	**30**	**5**

Comparability

Comparability is the applicability of the project's data to the project's decision rule. The decision rules used for this project will be determined based on reference data for sediment and habitat conditions based upon regional data, internal data (no/limited human impact), and literature values.

Completeness

Completeness is a measure of the amount of data prescribed for assessment activities and the usable data actually collected, expressed as a percentage.

Completeness as % = (No. Valid Data Points or Samples / Total # Data Points or Samples) x 100

The overall project goal is 90% completeness. Sites lost due to inaccessibility will reduce the total number of sites in the equation but not the completeness goal. Data results qualified with R flags will count against completeness. Data with J flags will not affect completeness. If any listed stream has less than 50% of its planned sites sampled due to accessibility issues, the project conclusions will note this fact and account for the increased uncertainty in the TMDLs margin of safety.

DQIs

Precision

Precision refers to the degree of agreement among repeated measurements of the same characteristic. DEQ has tested the reproducibility of the measurements employed in this design and found that the precision of repeat measurements is sufficient relative the total variance from cell to cell. The greatest source of result variance comes from the heterogeneity of a study site (due to natural/human disturbance variability) rather than systematic and random error of individual measurements. Therefore, DEQ feels that precision of measurements is controlled satisfactorily through training and adherence to the sampling protocols described in *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2010).

Sensitivity

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. Similar to precision, the sensitivity of measurements was tested during method development. No modification to the measurement increments or units specified *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2010) are allowed without consent from the DEQ TMDL Project Manager.

Bias

Bias is directional error from the true value. In this context, it is an extension of the representativeness concept applied to an individual sample. Bias can occur either during site selection or measurement.

The stratification criteria (DEQ 2008) used to assist with site selection in this study is designed to reduce bias and identify sites that are representative of the natural (physical) influences of sediment loading, transport, and deposition in contrast to sites with non-natural (anthropogenic) influence. Because the stratification of a watershed is so key to controlling bias in the resulting data, all decisions made during the stratification process will be overseen by the DEQ TMDL Project Manager.

5.0 Data Analysis, Record Keeping, and Report Requirements

A review of field data will be conducted following receipt of the field data package. All data collected as part of this SAP will be evaluated against the methods cited in **Section 4.0**. Data qualifiers (see below) should be assigned to data that does not appear to have followed these processes.

> J - The associated numerical value is an extreme outlier to the dataset but the process appears to have been followed based on the supporting data and field notes. The use of a "J" qualifier allows the TMDL project manager to consider whether the value should be used outright, with caution, or censured from the dataset.
>
> R – The associated numerical value is an extreme outlier to the dataset and the process appears NOT to have been followed based on the supporting data and field notes. The data are unusable; resampling and/or reanalysis are necessary if completeness goal is not met due to this data being rejected.

Summary of Data Quality

A summary discussion of data quality will be prepared following review of field documentation and data. The data quality analysis will summarize the QA/QC information from the field event, audit information, corrective actions taken (if any), and the overall results of sampling activities with respect to compliance with the provisions of this SAP. The primary focus of the data quality analysis will be an estimate of the effects that any deviations from approved procedures may have on the project objectives or data uses.

Data generated during this project will be stored on field forms and in electronic spreadsheets and summary reports. Written field notes and forms will be processed by DEQ staff following QA/QC procedures to screen for data entry errors. All approved data will be inputted into an electronic spreadsheet format for future analysis purposes.

6.0 Schedule for Completion

Sampling is scheduled for September of 2010.

7.0 Project Team Responsibilities

Kristy Zhinin – DEQ Project Manager
Mindy McCarthy – DEQ Quality Assurance Officer
Steve Cook and Christina Staten – DEQ Field Crew
Amy Chadwick – Watershed Consulting – Lead Ecologist
Pedro Marques and Kurt Von Kleist – Watershed Consulting Field Crew
Christine Brissette and Lucas McIver - Watershed Consulting Alternate Field Crew
Peter Petri – Watershed Consulting GIS and Technical Support

8.0 References

Kaufmann, P.R. 2000. Physical Habitat Characterization of Non-Wadeable Rivers. Pages 6.1-6.29 in J. M. Lazorchack, B.H. Hill, D.K. Averill, D.V. Peck, and D.J. Klemm (eds.), Environmental monitoring and assessment program – surface waters: field operations and methods for measureing the ecological condition of non-wadeable rivers and streams. U.S. Environmental Protection Agency, Cincinnati, Ohio.

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